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CHANGES IN ANTHROPOMETRIC MEASUREMENTS DUE TO MIGRATION AND ENVIRONMENT
A PRELIMINARY OBSERVATION

ABSTRACT: The observations are to highlight the impact of migration and environment on the anthropometric characters among the Santals and Mundas of Assam, who migrated from Bihar. The anthropometric data collected from both the migrant and parental groups have been put in comparative assessment to find out the changing patterns. The study shows that immigrant Santals differ from their parental group with higher values, in case of immigrant Mundas it is just the opposite.

INTRODUCTION

Populations of the same biological group are sometimes found to differ one from another in physical and genetical characters due to migration and environmental factors. Different environmental factors like climate, topography, ecology, nutrition, hygienic condition, diseases, etc. may induce such variations.

The work of various scholars like Boas (1911), Buzarbaruah (1985, 1989), Das (1960), Laskar (1952, 1954), Oliver and Howels (1957), Sarkar (1955), Shapiro (1939) and Thurston (1909) have revealed such variations of different degrees and of different nature in some populations of India and abroad.

In the present work an attempt has been made to study variations in respect of some anthropometric measurements among the immigrant Santals and Mundas, whose forefathers were brought to Assam from their original habitats as labour force. The results of the two phases of the study are discussed in comparative perspective. One deals with the comparison of anthropometric characteristics of the descendants of the migrant group, with their kin population in Bihar. The other considers the modifications which a change of environment may produce in the physical traits of immigrants. For this purpose the author has selected two migrant groups, the Santals and the Mundas who immigrated Assam from Bihar as tea-garden labourers.

Since 1840 A.D. the Santals and Mundas migrated to Assam as tea-garden labourers from Bihar, West-Bengal, Orissa, etc. Now, they have settled in the tea-gardens and also in the vicinity of the tea-gardens all over the state. At the initial stage these groups of people lived primarily and exclusively within the tea-garden areas and gradually they came out of the seclusionary habitat and started settling in the vicinity (but outside the tea-garden areas) forming some villages. A large number of immigrant Santals inhabited various parts of the Goalpara and the

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Kamrup districts of Assam. In the Nagrijuli area of Kamrup district their population is dense. In case of the immigrant Mundas, a large section of them live in the Sonari area of Sibsagar district of Assam forming some villages.

The immigrant Santals' primary occupation is agriculture, a few of them work in the tea-gardens as temporary labourers. Rice and wheat is their staple food. The majority of them are used to drinking rice beer, a home-made beverage. Their socio-economic condition is moderate. The immigrant Santals inhabiting the Nagrijuli area are not influenced by the urban way of living, as their villages are situated far away from towns and cities. Thus, they are not affected by urbanisation and they still preserve their traditional way of living and agriculture. Agriculture is the primary occupation of Santals of the parental group, but some of them are in white collar jobs. They are also used to drinking liquor which is prepared from rice or 'mahua' flowers. Their socio-economic condition is very poor in comparison with immigrant Santals. Therefore, they consume very poor food.

The sample of immigrant Munda population is drawn from three tea-gardens of Sibsagar district, Assam. Rice and wheat are their staple food. The majority of them are used to drinking alcoholic liquor. The Jabaka, Naphuk and Tawkak tea-gardens are located in the heart of Sonari town of Sibsagar district and the labourers of these gardens are exposed to the urban style of living. Consequently, these people spend nearly 50 % of their total income in luxurious goods and other entertainments to cope up with the urban style of life. However, their daily diet remains sub-standard. The parental population sample is drawn from three villages of Khunti area in Ranchi district of Bihar. Their primary occupation is agriculture, some of them are in white collar jobs. Their staple food and consumption pattern of alcoholic drinks do not differ from the parental population of Santals. Their socio-economic condition is moderate. Out of the total population of these three villages 32 % adopted Christianity, and the rest are Hindus. The percentage of literacy among them is 31. Their sanitation and hygienic condition is better than that of their immigrant counterparts in Assam.

Ranchi and Santal Paragana districts are characterized by undulating plateaus composed of isolated table-lands with the altitude from 300 to 400 meters above sea level. Generally, narrow streams which remain dry during winter flow through these areas. The climate is dry. The average temperature raises from 22.4 °C in December to 60 °C in May. The rainfall varies from 50 inches to 56 inches. Humidity is relatively high in the monsoon season. During the rest of the year, the air is generally dry.

The Sibsagar and Kamrup districts are located in the Brahmaputra valley, the altitudes of which range from 81 meters to 115 meters above sea level. The average temperature raises from 9.8 °C in December to 42.8 °C in May. The rainfall varies from 78.74 cm to 98.46 cm. Humidity is very high in the

monsoon season, as compared to the rest of the year (District gazetteer of Ranchi, Santal Paragana, Sibsagar and Kamrup districts, 1972, Govt. of India publication).

The Santals and Mundas are endogamous people and practice clan exogamy. Joint family system is prevalent. They are Dravidian people — Risley (1925), Guha (1935) and Haddan (1942) classified them as Proto-Australoid groups. They are short to medium and dark-brown coloured people with elongated heads, short and broad noses with depressed nasal roots and medium to thick lips. Linguistically, they belong to Munda speaking groups.

MATERIAL AND METHODS

The sample for this study consists of 800 adult individuals of both sexes of the immigrant and parental population. One hundred male and one hundred female immigrant Santals of Nagrijuli area of Kamrup district, and one hundred male, one hundred female immigrant Mundas of Jabaka, Naphuk and Tawkak Tea-Estates of Sonari area of Sibsagar district, Assam, were collected during the year 1981. One hundred male and one female immigrant Santals of Dumka area of Santal Paragana district, and one hundred male and one hundred female Mundas of Khunti area of Ranchi district of Bihar were collected during the year 1982.

The immigrant Santal and Munda samples were collected from those individuals whose forefathers immigrated from Santal Paragana and Ranchi districts respectively and settled in Assam. The samples were collected from adult members ranging from 21 to 45 years. For the purpose of study this range has been divided into five categories: 21 to 25 years, 26 to 30 years, 31 to 35 years, 36 to 40 years and 41 to 45 years. Data are drawn from 20 individuals of each category of both sexes.

In the course of investigation the following measurements were taken: stature height, sitting height, height of tragus, head height, head breadth, head length, horizontal circumference of head, bi-zygomatic breadth, upper facial height, nasal height, nasal breadth, length of hand, breadth of hand, lower arm girth, upper arm girth, bi-acromial breadth and body weight. The following indices have been calculated: cephalic index, breadth-height and length-height indices of head, upper and total facial indices and nasal index. All the measurements have been taken during morning hours.

The methods prescribed by Martin have been used for collecting and analysing the data (c.f. Sing and Bhasin 1968). The head-height has been obtained by subtracting height tragus from the height vertex. Some information has been collected from the tea-garden and local hospital records. The mean, standard deviation, the coefficient of variation are calculated and for the purposes of comparison chi-square and t-tests have been used.

RESULTS

The frequency distribution of stature is shown in *Table 1a*. The immigrant Santal males show less than medium stature in the average. In the average of the immigrant Mundas and the parental Santals the stature is short. But parental Munda males show medium stature on the average.

In case of females the immigrant Santals and parental Mundas have medium stature on the average, but the immigrant Mundas and parental Santals show short and below medium stature in the average respectively. Chi-square and t-values show that the immigrant groups significantly differ from their parental groups.

The frequency distribution of cephalic index is shown in *Table 1b*. All the groups of the male Santals and Mundas possess dolichocephalic head in the average. In case of Munda females both groups possess mesocephalic head in the average.

The frequency distribution of length-height and breadth-height head indices are shown in *Tables 1c and 1d*. Both the sexes of immigrant and parental Santals and Mundas possess hypsicephalic head in the average. All these four groups also possess acrocephalic head in the average.

The frequency distributions of upper facial index and total facial index are shown in *Tables 1e and*

TABLE 1a. *Percentage frequencies of different types of characters among the Santal and Munda males. (Stature)*

Class in cm	Immigrant Santal Males	Parental Santal Males	Immigrant Munda Males	Parental Munda Males
Very short (130.0 – 149.9)	7	12	8	3
Short (150.0 – 159.9)	24	61	75	5
Below medium (160.0 – 163.9)	50	21	8	20
Medium (164.0 – 166.9)	12	5	5	63
Above medium (167.0 – 169.9)	6	1	4	8
Tall (170.0 – 179.9)	1	–	–	1,
Chi-square value	37.07 (d.f. -5)	.001 > p	123.66 (d.f. -5)	.001 > p

TABLE 1a. *Percentage frequencies of different types of characters among the Santal and Munda females. (Stature)*

Class in cm	Immigrant Santal Females	Parental Santal Females	Immigrant Munda Females	Parental Munda Females
Very short (121.0 – 139.9)	2	6	21	–
Short (140.0 – 148.9)	14	10	59	5
Below medium (149.0 – 152.9)	20	64	13	17
Medium (153.0 – 155.9)	58	18	5	66
Above medium (156.0 – 158.9)	6	2	2	11
Tall (159.0 – 167.9)	–	–	–	1
Chi-square value	48.77 (d.f. -5)	.001 > p	126.74 (d.f. -5)	.001 > p

TABLE 1b. *Cephalic index.*

	Immigrant Santal		Parental Santal		Immigrant Munda		Parental Munda	
	Males	Fem.	Males	Fem.	Males	Fem.	Males	Fem.
Hyper-dolicho-cephaly (– 69.9)	6	3	7	8	–	4	6	1
Dolicho-cephaly (70.0 – 75.9)	70	62	65	70	84	12	73	10
Meso-cephaly (76.0 – 80.9)	21	28	22	16	13	65	11	85
Brachy-cephaly (81.0 – 85.4)	2	7	6	6	3	15	10	4
Hyper-brachy-cephaly (85.0 –)	1	–	–	–	–	4	–	–
Chi-square value								
Males	2.29 (d.f. -4)		.70 > p > .50		10.71 (d.f. -3)		.02 > p > .01	
Females	6.11 (d.f. -4)		.20 > p > .10		34.64 (d.f. -4)		.001 > p	

TABLE 1c. *Lenght-height index of the head.*

	Immigrant Santal		Parental Santal		Immigrant Munda		Parental Munda	
	Males	Fem.	Males	Fem.	Males	Fem.	Males	Fem.
Ortho-cephal (58.0 – 62.9)	4	5	7	8	5	4	6	3
Hypsi-cephal (63.0 –)	96	95	93	92	95	96	94	97
Chi-square value								
Males	0.82 (d.f. -1)		.50 > p > 30		0.10 (d.f. -1)		.80 > p > .70	
Females	0.74 (d.f. -1)		.50 > p > 30		0.17 (d.f. -1)		.70 > p > .50	

If respectively. The immigrant Santal males possess mesene and leptoprosopic type of face in the average, but the parental Santal males possess euryene and mesoprosopic type of face. The immigrant and the parental male Mundas possess euryene and euryprosopic type of face in the average, but in case of the females the four groups possess euryene and hypereuryprosopic type of face in the average.

The frequency distribution of nasal index is shown in *Table 1g*. Except for immigrant Santal males, all of them possess platyrrhine type of nose in the average. The immigrant Santal males possess mesorrhine nose in the average.

The *Tables 2a, 2b, 2c and 2d* show that the immigrant Santals differ from their parental group in higher values, on the other hand the immigrant Mundas differ from their parental group in lower values.

TABLE 1d.   *Breadth-height index of the head.*

	Immigrant Santal		Parental Santal		Immigrant Munda		Parental Munda	
	Males	Fem.	Males	Fem.	Males	Fem.	Males	Fem.
Tapeino-cephal (– 78.9)	–	–	–	–	2	–	–	–
Metrio-cephal (79.0–84.9)	7	5	6	7	2	9	3	6
Acro-cephal (85.0 –)	93	95	94	93	96	91	97	94
Chi-square value								
Males	0.08 (d.f. -1)		.80 > p > .70		2.21 (d.f. -2)		.50 > p > .30	
Females	0.35 (d.f. -1)		.70 > p > .50		0.55 (d.f. -1)		.80 > p > .70	

TABLE 1e.   *Upper facial index.*

	Immigrant Santal		Parental Santal		Immigrant Munda		Parental Munda	
	Males	Fem.	Males	Fem.	Males	Fem.	Males	Fem.
Hyper-euryene (– 42.9)	3	8	4	7	7	18	16	12
Euryene (43.0–47.9)	14	68	58	65	74	67	71	69
Mesene (48.0–52.9)	66	21	23	20	6	11	9	13
Leptene (53.8–56.9)	14	3	12	4	12	4	4	6
Hyper-leptene (57.0 –)	3	–	3	4	1	–	–	–
Chi-square value								
Males	47.82 (d.f. -4)		.001 > p		2.14 (d.f. -4)		.08 > p > .70	
Females	2.77 (d.f. -4)		.70 > p > .50		1.80 (d.f. -3)		.70 > p > .50	

It is also observed that out of 18 measurements and 6 indices the immigrant Santal males are significantly different from their parental group in 13 measurements and 1 index. In case of females the immigrant Santals significantly differ from their parental group in 10 measurements and 2 indices. Among the immigrant Munda males, they are significantly different from their parental group in 13 measurements and 2 indices. In case of female Mundas the immigrant group differ significantly from their parental group in 17 measurements and 3 indices.

TABLE 1f.   *Total facial index.*

	Immigrant Santal		Parental Santal		Immigrant Munda		Parental Munda	
	Males	Fem.	Males	Fem.	Males	Fem.	Males	Fem.
Hyper-eurypro-sopic (– 78.9)	2	51	1	56	27	63	17	59
Eury-prosopic (79.0–83.9)	13	28	12	30	63	19	61	25
Meso-prosopic (84.8–87.9)	50	18	48	12	6	10	21	11
Lepto-prosopic (88.0–92.9)	22	3	36	1	3	8	1	4
Hyper-lepto-prosopic (93.0 –)	13	–	3	1	1	–	–	1
Chi-square value								
Males	18.56 (d.f. -4)		.001 > p		9.37 (d.f. -4)		.10 > p > .05	
Females	3.50 (d.f. -4)		.50 > p > .30		3.30 (d.f. -4)		.70 > p > .50	

TABLE 1g.   *Nasal index.*

	Immigrant Santal		Parental Santal		Immigrant Munda		Parental Munda	
	Males	Fem.	Males	Fem.	Males	Fem.	Males	Fem.
Lepto-rrhine (55.0–69.9)	2	–	1	1	–	–	3	1
Mesorrhine (70.0–84.9)	69	24	30	27	20	25	25	20
Platyrrhine (85.0–99.9)	24	70	65	69	72	66	70	72
Hyper-platyrrhine (100.0 –)	5	6	4	3	8	9	2	7
Chi-square value								
Males	34.70 (d.f. -3)		.001 > p		4.11 (d.f. -3)		.50 > p > .30	
Females	2.16 (d.f. -3)		.70 > p > .50		1.62 (d.f. -3)		.70 > p > .50	

TABLE 2a.   *Statistical constants of the measurements and indices with their respective standard errors and t-values of Santal males.*

Characters	Immigrant Santal		Parental Santal		t-value
	Mean	± S.E.	Mean	± S.E.	(d.f. α)
Stature	162.28±	.46	159.42±	.45	4.60*
Height of tragus	149.28±	.51	146.81±	.51	3.42*
Sitting height	81.30±	.42	80.31±	.28	1.96*
Head height	13.00±	.06	12.61±	.06	4.60*
Head breadth	13.81±	.08	13.48±	.07	3.10*
Head lenght	18.51±	.07	18.10±	.07	4.14*
Bizygomatic breadth	12.11±	.06	12.12±	.06	0.12
Nasal height	4.52±	.03	4.42±	.03	2.36*
Nasal breadth	3.85±	.05	3.78±	.04	1.09
Upper facial height	6.20±	.05	6.13±	.09	0.68
Total facial height	10.66±	.10	10.64±	.60	0.03
Lower arm girth	23.29±	.08	21.80±	.09	12.37*
Upper arm girth	23.71±	.10	22.10±	.10	11.38*
Length of hand	17.87±	.06	17.61±	.07	2.82*
Breadth of hand	9.73±	.04	9.63±	.05	0.16
Biacromial breadth	37.15±	.10	35.82±	.09	9.89*
Horizontal circumference of head	55.78±	.12	53.62±	.11	13.27*
Body weight	50.78±	.22	46.70±	.24	12.52*
Cephalic index	74.61±	.26	74.48±	.28	0.34
Length-height index of head	70.23±	.36	69.67±	.38	1.07
Breadth-height index of head	94.13±	.41	93.55±	.45	0.95
Upper facial index	49.55±	.27	46.88±	.28	6.86*
Total facial index	88.03±	.38	87.79±	.38	0.45
Nasal index	84.73±	.48	85.00±	.44	0.41

* Indicate statistically significant

TABLE 2b.   *Statistical constants of the measurements and indices with their respective standard errors and t-values of Santal females.*

Characters	Immigrant Santal		Parental Santal		t-value
	Mean	± S.E.	Mean	± S.E.	(d.f. α)
Stature	153.62±	.41	151.74±	.38	3.36*
Height of tragus	141.20±	.42	139.64±	.40	2.69*
Sitting height	78.10±	.26	76.82±	.24	3.62*.
Head height	12.42±	.06	12.10±	.04	4.44*
Head breadth	13.20±	.06	12.86±	.06	4.01*
Head lenght	17.41±	.07	17.24±	.08	1.60
Bizygomatic breadth	12.50±	.05	12.40±	.05	1.41
Nasal height	3.94±	.05	3.83±	.04	1.72
Nasal breadth	3.54±	.05	3.51±	.05	0.42
Upper facial height	5.41±	.04	5.38±	.03	0.60
Total facial height	9.38±	.06	9.31±	.05	0.90
Lower arm girth	20.80±	.09	19.61±	.08	9.88*
Upper arm girth	21.60±	.11	20.41±	.10	8.00*
Length of hand	16.44±	.07	16.38±	.05	0.70
Breadth of hand	8.12±	.05	8.10±	.06	0.26
Biacromial breadth	35.40±	.12	34.38±	.09	6.80*
Horizontal circumference of head	53.00±	.12	51.62±	.11	8.48*.
Body weight	48.50±	.25	45.50±	.21	9.19*
Cephalic index	75.82±	.29	74.59±	.26	3.16*
Length-height index of head	71.34±	.24	70.19±	.26	3.25*
Breadth-height index of head	94.09±	.33	94.09±	.33	–
Upper facial index	43.28±	.23	43.38±	.24	0.30
Total facial index	75.04±	.31	75.08±	.29	0.09
Nasal index	90.86±	.38	91.64±	.31	1.59

* Indicate statistically significant

DISCUSSION

The stature is dependent on two factors: the idiotypical (heriditary) and paratypical (environmental) influence. Human stature depends on the interactions of many genes which are related to general growth of the body. It is also influenced by some internal secretion of the pituitary and other glands. Therefore it is heriditary but highly influenced by environmental factors as well.

Gouldstein (1943) observed that the stature of American sailors was lower than that of the soldiers of the same race who were better fed. Ivanovsky's (1923) study reveals that the Great-Russian males and females of richer and higher socio-economic classes showed an average of 4.7 cm and 6.6 cm decrease respectively

in stature during the period of famine. The present work also agrees with Ivanovsky's study that females are more affected in comparison to males. He also observed that not only stature but other parts of the body become smaller during the period of famine. Martin (1928) has shown that the stature of German youths was lower in those who suffered from malnutrition during World War I and the post-war period.

It is also observed from the above mentioned work that the stature depends on different occupations, social classes and other environmental conditions. The relation between growth in height and environmental factors has been analysed in growth studies statistics conducted in Japan. Nutrition, especially calcium intake is suspected as being a factor directly responsible for variations in growth. Growth in stature was low during the war times due to inade-

TABLE 2c. *Statistical constants of the measurements and indices with their respective standard errors and t-values of Munda males.*

Characters	Immigrant Santal Mean ± S.E.	Parental Santal Mean ± S.E.	t-value (d.f. α)
Stature	157.82± .44	161.39± .52	5.24*
Height of tragus	145.11± .63	148.39± .59	3.80*
Sitting height	80.52± .26	81.46± .37	2.08*
Head height	12.71± .07	13.00± .08	2.73
Head breadth	13.88± .04	14.00± .09	1.22
Head length	18.50± .06	18.63± .06	1.53
Bizygomatic breadth	12.88± .06	12.92± .03	0.47
Nasal height	4.24± .03	4.31± .02	1.94
Nasal breadth	3.86± .04	3.95± .05	1.41
Upper facial height	5.58± .04	5.82± .03	4.80*
Total facial height	10.30± .10	10.52± .05	1.98*
Lower arm girth	22.15± .09	23.00± .08	9.55*
Upper arm girth	22.02± .10	23.35± .09	2.45*
Length of hand	17.00± .06	17.55± .07	4.28*
Breadth of hand	9.11± .04	9.29± .05	2.81*
Biacromial breadth	36.32± .10	37.59± .17	6.44*
Horizontal circumference of head	55.94± .11	55.00± .11	6.04
Body weight	45.76± .29	51.00± .42	12.56*
Cephalic index	75.03± .24	75.15± .29	0.32
Length-height index of head	68.70± .32	69.78± .54	1.72
Breadth-height index of head	91.57± .44	92.86± .64	1.66
Upper facial index	43.32± .28	45.05± .26	4.53*
Total facial index	79.97± .39	81.41± .49	2.31*
Nasal index	91.03± .56	91.65± .50	0.83

*Indicate statistically significant

TABLE 2d. *Statistical constants of the measurements and indices with their respective standard errors and t-values of Munda females.*

Characters	Immigrant Santal Mean ± S.E.	Parental Santal Mean ± S.E.	t-value (d.f. α)
Stature	147.83± .39	153.90± .33	11.88*
Height of tragus	135.58± .49	141.48± .34	9.89*
Sitting height	74.64± .24	76.02± .21	4.34*
Head height	12.25± .05	12.42± .03	2.92*
Head breadth	13.58± .04	13.76± .03	2.40*
Head length	17.44± .05	17.75± .04	4.84*
Bizygomatic breadth	12.32± .03	12.42± .03	2.36*
Nasal height	3.97± .05	4.15± .05	2.55*
Nasal breadth	3.62± .08	3.67± .05	0.53
Upper facial height	5.37± .03	5.59± .05	3.77*
Total facial height	9.41± .05	9.66± .04	3.90*
Lower arm girth	21.41± .08	23.70± .26	15.11*
Upper arm girth	20.59± .07	23.23± .09	23.15*
Length of hand	16.54± .05	16.74± .05	2.83*
Breadth of hand	8.52± .03	8.71± .04	3.80*
Biacromial breadth	32.63± .28	35.31± .11	8.91*
Horizontal circumference of head	52.57± .12	53.64± .08	7.42*
Body weight	41.65± .36	46.31± .29	9.81*
Cephalic index	77.64± .26	77.52± .27	0.32
Length-height index of head	70.24± .29	69.97± .35	0.59
Breadth-height index of head	90.21± .44	86.56± .60	4.91*
Upper facial index	43.24± .24	44.86± .17	5.51*
Total facial index	75.76± .36	77.53± .27	3.93*
Nasal index	88.66± .21	88.43± .56	0.38

*Indicate statistically significant

in stature was low during the war times due to inadequate diet in the rural districts of Japan among the poorer and the lower socio-economic classes.

All the parts of a living human body are also a useful index for assessing the nutritional status. The lack of proteins and carbohydrates cause retardation of growth (Acheson 1960). Growth is limited among those who suffer chronically from parasitic disease (Scott 1965). It is also observed from the present study that the immigrant Mundas suffer from parasitic disease and consume poor food. The parental Santals also consume poor food. The reduction in anthropometric measurements in the immigrant Mundas may be due to disease, poor food along with other factors. Because the parental Santals show lower anthropometric measurements than the immigrant Santals, the anthropometric variation may be due to poor food along with other factors.

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